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<p>(21) International Application Number: PCT/US94/05511 (22) International Filing Date: 18 May 1994 (18.05.94) (30) Priority Data: 08/064,521 19 May 1993 (19.05.93) US 08/197,297 16 February 1994 (16.02.94) US (71) Applicant: CALIFORNIA SOUTH PACIFIC INVESTORS [US/US]; Harton Hall, 1401 South Oak Knoll, Pasadena, CA 91109 (US). (72) Inventors: GOLDSMITH, Robert, M.; Harton Hall, 1401 south Oak Knoll, Pasadena, CA 91109 (US). GOLDSMITH, Catherine, H.; Harton Hall, 1401 south Oak Knoll, Pasadena, CA 91109 (US). WOODAMAN, James, G.; 1512 Altadena Drive, Pasadena, CA 91107 (US). (74) Agent: RAHN, LeRoy, T.; Christie, Parker &amp; Hale, P.O. Box 7068, Pasadena, CA 91109-7068 (US).</p>		<p>(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</p>
<p>(54) Title: DETECTION OF CONTAMINANTS IN FOOD</p> <p>(57) Abstract</p> <p>A food contamination detector comprises an indicator (16) bound to a substrate (20), wherein the indicator is in communication with juices from food (12) to be tested for the presence of a toxin. A means for changing the color of the indicator when the toxin is present in the juices from the food is provided to indicate that the food is contaminated.</p> <div data-bbox="673 1150 1312 1360"></div> <div data-bbox="771 1396 1242 1669"></div>		

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**DETECTION OF CONTAMINANTS IN FOOD****Related Applications**

This application is a continuation in part of U.S. Application Serial No. 08/064,521 filed May 19, 1993, which is incorporated herein by reference.

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**Field of the Invention**

The present invention relates to detection of the presence of toxic contaminants in food.

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**Background of the Invention**

Over the past several years there has been increasing concern over the safety of our food supply. Contamination of food can come from a variety of sources and the type of contamination possible is often dependent on the food involved.

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Most animal derived food products, such as raw meat, are exposed to the possibility of contamination before, during or after processing. Such contamination comes from, for example, contact with faecal matter at the slaughter house, from handlers of the food products at any stage of the processing of the food products or from toxins, both naturally occurring and man-made, present in the environment where the food was grown or processed. In most cases, contamination is minor and, if the food is prepared properly, is not a serious threat to the consumer. However, while the contamination of food is generally low, i.e. few bacteria per gram of the food, if

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1 the food is not stored under satisfactory conditions or  
stored for long periods of time, contaminants, such as  
bacteria, grow to become a serious threat to the eventual  
consumer of the products. Even if the food products reach  
5 the market in an acceptable condition, subsequent  
treatment by the consumer may lead to the development of  
serious contamination of the food.

A number of incidents and factors have lead to the  
growing concern over the food supply. These include:

10 raw chicken and egg products have been found to  
be contaminated with *Salmonella* and inadequate  
cooking of such products has led to serious illness  
or death of persons who have consumed the  
contaminated products;

15 inadequately pasteurized milk products have  
been found to be contaminated with *Listeria* which  
has lead to serious illness or death of consumers of  
the products;

20 a highly toxic strain of *E. coli* has lead to  
the death of several people who consumed prepared  
beef products which had been inadequately cooked;

25 a number of toxins are known, such as  
ciguatoxins, which contaminate fish. These toxins  
are not inactivated or destroyed by cooking and so  
their presence in fish is a threat to any consumer  
of the product;

30 shell fish, such as oysters, concentrate any  
contaminants present in the water in which they grow  
and, since they are frequently eaten raw, pose a  
threat to the health of consumers; and

fish is increasingly eaten raw which adds to  
the possibility of increased outbreak of illness  
from water borne contaminants.

35 The only means the consumer has of determining if the  
food they purchase is contaminated is by visual inspection  
and by smell. These are usually inadequate to detect  
contamination.

1           There is a need for a reliable way to detect if a  
food product purchased by a consumer is fit for  
consumption. Any solution to this problem should be  
relatively inexpensive and able to detect a number of  
5       agents capable of causing illness. It should also be  
simple to "read" so that a consumer, who does not have  
access to sophisticated testing equipment or specialized  
knowledge, can readily determine if the products they have  
purchased are free from contamination.

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#### Summary of the Invention

          The present invention relates to a food contamination  
detector. The food contamination detector comprises an  
indicator bound to a substrate. The indicator is in  
15       communication with juices from food which are to be tested  
for the presence of a toxin.

          A means for changing the color of the indicator when  
the toxin is present in the juices from the food is  
provided to indicate that the food is contaminated. In  
20       one embodiment of the invention the means for changing the  
color comprises a labeled antibody which dissociates from  
the substrate in the presence of a toxin. In another  
embodiment the means for changing color comprises a  
labeled antibody which binds to the substrate in the  
25       presence of a toxin. In another embodiment the change in  
color results in a change in a bar code.

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1     Brief Description of the Drawings

These and other features and advantages of the present invention will be better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which:

5     FIG. 1 is a top view of a packaged food product;

FIG. 2 is a bottom view of the packaged food product with a bar code detector system;

10    FIG. 3 is a side sectional view of the packaged food product showing the bar code detector system in the package;

FIG. 4 is one embodiment of the bar code detector system of the present invention, prior to attachment to a food package;

15    FIG. 5 is a schematic diagram of a bar code reader for use in the present invention;

FIG. 6 is a side sectional view of another embodiment of the bar code detector system in a package tray without food;

20    FIG. 6A is an enlarged view of part of FIG. 6;

FIG. 7 is a perspective view of the bottom of the absorbent liner of FIG. 6 with one component of the bar code system attached;

25    FIG. 8 is a front view of the component shown in FIG. 7;

FIG. 9 is a front view of another component of the bar code system of FIG. 6;

30    FIG. 10A is a front view of the components of FIGS. 8 and 9 as they appear from the outside of the food package in the absence of contamination;

FIG. 10B is a front view of the components of FIGS. 8 and 9 as they appear from the outside of the food package in the presence of contamination;

35    FIG. 11 is a side sectional view of another embodiment of a bar code detector system in a package tray without food;

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1           FIG. 12 is a perspective view of a liner for use in  
a variation of the bar code system of FIG. 11;

5           FIG. 13 is a perspective view of a carcass indicator  
strip incorporating principle of the invention prior to  
reaction with toxins; and

10           FIG. 14 is a perspective view of the carcass  
indicator strip of FIG. 13 after reaction with toxins.

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1     Detailed Description of the Specific Embodiments

          The present invention uses an indicator which may be  
in the form of words, symbols or part of a bar code that  
identifies the product at point of purchase, sale, or  
5     distribution as a detector system for toxins and other  
contaminants that may be present in food products. As  
used herein toxin means chemicals or pathogenic organisms  
which may be transferred from food to the consumers of the  
food, or other agents which may be toxic or result in  
10    illness in the consumer of the contaminated food products.

          The invention is described in the context of bar  
codes because this is currently the prevalent way to  
identify food products, including information about  
product type, quantity, price, unit price, and origin in  
15    a machine readable manner. The invention is applicable,  
however, to other product identifying systems, machine  
readable and/or readable to a human. When the term  
"visible" is used herein, it means visible or readable by  
a bar code reader or other scanning apparatus.

20     The same reference numbers are used throughout the  
drawings to identify similar parts or elements.

          Food products are often "mass produced" and sold at  
retail outlets in prepackaged containers such as that  
illustrated in FIGs. 1-3. Typically, such packages  
25    include a styrofoam tray 10 which contains the food  
product 12. The tray and food are sealed in a transparent  
plastic wrap material 14. An absorbent pad 15 lies  
between food product 12 and the inside bottom of tray 10.

          A bar code system 16 is used on the products for scanning  
30    at the check-out register (FIG. 5), to reduce errors in  
totaling purchases and for stock control. The bar code  
system comprises a series of bars which represent a  
number, identifying the product. In the practice of the  
present invention the product identifying system, e.g.,  
35    the bar code system, also serves the purpose of detecting  
toxins in the food products.

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1 In the embodiment of FIGs. 1-3, bar code system 16 is  
printed on a transparent membrane or substrate 20. One  
side of substrate 20 has a self-adhesive surface for  
attachment to the interior of tray 10 and the other side  
5 of substrate 20 has printed on it bar code system 16. The  
bottom of styrofoam tray 10 has a rectangular hole 18.  
Hole 18 is covered by a window 21 formed by a transparent  
sheet of material such as MYLAR® (a trademark of DuPont)  
using a suitable adhesive to seal the MYLAR to the  
10 styrofoam material. Hole 18 and window 21 also serve as  
a collector 19 for liquids and juices from food product 12  
so the latter can come into contact with bar code  
system 16. Substrate 20 can be prepared with a peelable,  
protective release layer 22 (FIG. 4), which covers bar  
15 code system 16 prior to its application to a package. At  
the site of packaging of food product 12, release layer 22  
is peeled off and the adhesive side of substrate 20 is  
placed on the inside surface of window 21 so that bar code  
system 16 faces the interior of the package and is exposed  
20 to the juices of food product 12. Alternatively,  
substrate 20 could also serve as the window, in which case  
it would be attached to, cover, and seal hole 18.

The bar code system is formed by labeled antibodies  
bound to antigens. The labeled antibodies function as an  
25 "ink" and are "printed" in a bar code pattern on the  
transparent substrate 20. First, the antigens are bound  
to the entire surface of substrate 20 or the portion of  
its surface on which the bar code system is to be placed.  
Then, the bar code system is applied to the antigen coated  
30 surface of substrate 20 by a bar code printer, using the  
labeled antibody as the ink. Preferably, bar code  
system 16 serves the normal product identifying function  
of a bar code, i.e., it represents price, price per unit,  
type of product, origin, and quantity or weight  
35 information. As illustrated in FIG. 5, food packages  
carrying bar code system 16 are passed under a bar code  
scanner or reader 24 mounted on a counter 25 at the point

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1 of sale to read the product information in the usual way.  
A store computer 26 processes this information to totalize  
the amount of purchase and to manage inventory.

5 The bar code system for use in the invention is  
prepared by irreversibly binding an antigenic determinant  
of toxins or contaminants of interest to the transparent  
substrate. The antigenic determinant may be a small  
portion of the toxin, which is specific for that toxin, it  
may be the toxin itself, an analog of the toxin or other  
10 compound which is capable of "mimicking" the toxin, or  
pathogenic microorganisms, all of which are referred to  
herein as "toxins." Substrates suitable for binding the  
toxin are well known in the art. If substrate 20 serves  
as window 21 it must be impervious to the food juices.  
15 Suitable substrates include substrates such as those made  
from activated hydrophobic polyvinylidene, polyvinylidene  
difluoride, mixed esters of cellulose nitrate and  
cellulose acetate, hydrophobic polyvinylidene difluoride,  
hydrophilic polyvinylidene difluoride, laminated and  
20 unlaminated polytetrafluoroethylene, microfiber glass,  
cellulose and polypropylene. Once toxins are bound to the  
substrate other binding sites, which remain on the  
substrate, are blocked by contacting them with an "inert"  
binding agent such as bovine serum albumin or other  
25 suitable blocking agent.

Once the toxin is bound to the substrate a labeled  
antibody, which exhibits a specificity for the toxin, also  
referred to herein as anti-toxin, is bound to the toxin.  
Antibodies suitable for use in the present invention  
30 include monoclonal and polyclonal antibodies. The  
preparation of such antibodies, specific for a desired  
toxin, are well known in the art. In some cases it may be  
necessary to conjugate the toxin to a protein to "mask"  
the toxicity of the antigen. Otherwise injection of the  
35 toxic antigen may result in the death of the animal in  
which the antibodies are to be prepared. Methods of  
conjugating compounds are well known in the art and one

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1 such method is described by Hokama et al., *Mycotoxins and*  
2 *Phycotoxins '88*, A Collection of Invited Papers at the  
3 Seventh International IUPAC Symposium of Mycotoxins and  
4 Phycotoxins, Tokyo, Japan 1988, pp. 303-310 (Elsevier  
5 Science Publishers, Amsterdam), which is incorporated  
6 herein by reference.

7 In one embodiment of the present invention the  
8 antibody is labeled with a colored latex bead. The  
9 preparation of antibodies labeled with colored latex beads  
10 is well known in the art. Such labeled antibodies may be  
11 prepared by diluting latex beads in a solution such as  
12 phosphate-buffered saline (8.1 mM  $\text{Na}_2\text{HPO}_4$ , 1.5 mM  $\text{KH}_2\text{PO}_4$ ,  
13 137 mM NaCl, 1.6 mM KCl) and mixing the solution gently to  
14 suspend and distribute the latex beads in the solution.  
15 Preferably, about a 10% (wt/v) suspension of latex beads  
16 is diluted about 1:100, to give a suspension of about 0.1%  
17 (wt/v) latex beads. An antibody solution is added to the  
18 latex bead suspension. Preferably, about 0.3 to about 0.6  
19 mg of antibodies are added for each mg of latex beads,  
20 however, this ratio will vary depending on the specificity  
21 and sensitivity of the antibody preparation and the type  
22 of support being used. The amount of antibody to be used  
23 for the preparation of labeled antibodies is derived  
24 experimentally, using different dilutions of the antibody  
25 preparation. After addition of the antibody, the solution  
26 is gently mixed and incubated at about 4°C for about 16 to  
27 about 20 hours. At the completion of the incubation, the  
28 labeled antibodies are washed with phosphate-buffered  
29 saline, and the sensitivity and specificity of the labeled  
30 antibody preparation are tested.

31 The sensitivity and specificity of the labeled  
32 antibodies are tested by coating a substrate with a  
33 preselected amount of toxin. When contacted with the  
34 labeled antibody, the labeled antibody binds to the toxin,  
35 resulting in the development of the desired color on the  
36 substrate. The color which develops will not be washed  
37 off by rinsing in a solution such as phosphate-buffered

1 saline. Binding of the antibody to the toxin results in  
the development of color for the bar code pattern forming  
a bar code detector system named by the owner of this  
invention the SIRA BAR™ system. In effect, the labeled  
5 antibodies act as a type of "ink" so the bar code pattern  
can be visualized.

In use with raw meat products, the bar code detector  
system is exposed to juices from the meat. The juices  
collect in the collector and come in contact with the bar  
10 code system. If a toxin is present in the juices, the  
antibodies will release from the bar code pattern and bind  
to the toxins present in the juices, thus altering or  
destroying the bar code pattern. Such antibody type  
assays are in and of themselves well known in the art and  
15 are referred to as competitive assays.

A consumer can detect the presence of the toxin in the  
food product by a visual inspection of the bar code  
system. If the consumer does not notice the alteration of  
the bar code, it is detected by bar code reader 24 at the  
20 check-out counter (FIG. 5) because store computer is  
configured to emit an alarm to warn that a altered bar  
code system has been detected. The contaminated products  
can then be replaced with non-contaminated products.

A labeled antibody is one means of indicating the  
25 presence of a toxin or other contaminant in the juices of  
a food product. Those skilled in the art will be aware of  
other indicators such as chemical indicators, which are  
useful in the practice of the present invention. Instead  
of destroying the bar code, the bar code could be altered  
30 in some other way, e.g., by change of color, depending on  
the nature of the indicating system. In general, the  
alteration of the bar code is detectable by the bar code  
reader so contamination of products can be automatically  
determined by the electronics. Thus, the invention  
35 presents a format or vehicle to utilize existing toxin or  
contaminant indicating systems more effectively.

1           The bar code reader can also be used to indicate  
whether packaged products are in satisfactory condition at  
the time they left the supplier. If contaminated products  
are detected in the processing stream, the supplier can  
5       find out the source of contamination and implement  
remedial steps to ensure that the source of contamination  
is eliminated.

          The same toxin could be used for all the bars of the  
bar code system or one or more toxins could be used for  
10       different bars. In this way a number of contaminants or  
toxins, that are commonly associated with a particular  
food, can be detected by a single bar code system. The  
bar code system would not only indicate that the food was  
contaminated but would also indicate the type of  
15       contamination.

          In another embodiment of the present invention shown  
in FIGs. 6-10, the contamination indicator is incorporated  
in a bar code system having two components--one component  
inside the package and another component outside the  
20       package. A substrate 28 is attached to the bottom of an  
absorbent liner 30. Such liners are well known in the  
art. The liner is an absorbent material that draws juices  
and other fluids away from the meat to the surface of  
substrate 28. Substrate 28 is preferably pervious to the  
25       juices of the food product, but it does not need to be  
transparent. The position of substrate 28 on liner 30 is  
precisely set. As illustrated in FIGs. 7 and 8, one  
component of the bar code system comprises visible  
indicator elements 27 and 29 printed on the exposed  
30       surface of substrate 28. Indicator elements 27 and 29 may  
include a bar, a symbol, letters, or a combination  
thereof. In the illustrated embodiment indicator element  
27 comprises a bar, given the trademark SERA BAR™ by the  
owner of this invention, and indicator element 29  
35       comprises the word "NOT". Indicator elements 27 and 29  
are printed on substrate 28 using labeled antibodies as  
"ink", as described above.

1           In this embodiment, the bottom of styrofoam tray 10  
has a window 21 formed by a transparent sheet of material  
such as MYLAR® (a trademark of DuPont) using a suitable  
adhesive to seal the MYLAR to the styrofoam material. The  
5       liner and tray are designed so the liner can be precisely  
positioned in the bottom of the tray. For example, liner  
30 could be dimensioned so that when it is placed in tray  
10 it fills the bottom of the tray with substrate 28 in  
register with window 21. In this way, the close fit  
10       between liner 30 and tray 10 serves to insure that  
indicator elements 27 are precisely positioned with  
respect to the second component of the bar code system,  
which is placed on the exterior of the bottom of tray 10  
and wrap material 14. Alternatively, ridges (not shown)  
15       could be molded into the inside bottom surface of tray 10  
to position liner 30 precisely and hold it in place.

          As illustrated in FIG. 9, the second component of the  
bar code system comprises a word 30 and a plurality of  
bars 31 printed on an opaque substrate 32 with ordinary  
20       ink and cut out sections 33 and 34 die cut from substrate  
32. Section 33 is smaller than bar indicator element 27.  
Section 34 is larger than word indicator element 29. Bars  
31 perform the normal product identifying function of a  
bar code, i.e., they represent price, unit price, type of  
25       product, origin, and weight or quantity. Substrate 32 has  
the same dimensions as window 21 and is placed on the  
outside of wrap material 14 so substrate 32 coincides with  
window 21. As a result, the position of substrate 32 is  
precisely set relative to substrate 28 so that indicator  
30       elements 27 and 29 are aligned with cut outs 33 and 34,  
respectively, and are normally visible from outside the  
package. Indicator element 27 completely fills cut out  
section 33 and indicator element 29 fits totally within  
cut out section 34. In the illustrated embodiment, word  
35       30 is "CONTAMINATED".

          When substrates 28 and 32 are aligned, the first and  
second components fit together to form the bar code

1 system. As illustrated in FIG. 10A, the words "NOT  
CONTAMINATED" are visible from the exterior of the package  
and indicator element 27 and bars 31 can be read by a bar  
code reader when no contaminants are present in the food  
5 juices inside the package. When contaminants are present,  
the labeled antibodies from which indicator elements 27  
and 29 are formed react with the toxin and are removed  
from the substrate 28. As illustrated in FIG. 10B, this  
leaves only word 30 and bars 31 visible. In the absence  
10 of element 27, the bar code reader senses that the bar  
code system is "defective" and in the absence of element  
29 humans can visually observe that the contents of the  
package is "CONTAMINATED".

15 Since it is desirable to detect different toxins in  
different food products it is also desirable, to place  
indicator element 27 in different locations on substrate  
28 and cut out 33 in different locations on substrate 32  
aligned with the locations on substrate 28, depending upon  
the toxin to be detected.

20 The described two component bar code system can be  
used to great advantage with the conventional bar code  
applicator machines used to mark food products in  
supermarkets. Such machines have a conveyor on which  
wrapped food packages are transported past a weighing  
25 station and a bar code label application station into a  
temporary storage bin. At the label application station  
a label carrier roll is feed past a printer where the  
product information is printed on the bar code labels  
(substrate 32) . and under a blade where the bar code  
30 labels are released from the carrier and picked up by one  
or more robot arms for delivery to the packages. A worker  
punches a product identification code into a key pad. A  
controller calculates from the product identification code  
and from the weight the product information to be printed  
35 on the label such as price, weight, unit price, and  
historical data, i.e., origin, and controls the printer to  
print the bar code pattern and alphanumeric characters on

1     the labels. The controller coordinates, i.e., times, the  
operation so the labels are applied to the proper  
packages.

5     A preferred method will now be described for using  
the two component bar code system with a modification of  
the conventional bar code applicator machines used to mark  
food products such as meat, poultry, or fish, in  
supermarkets. In a central processing plant, indicator  
10    elements 27 and 29 are printed on substrates 28 with a  
labeled antibody or other contaminant detector as ink;  
then substrates 28 are mounted on liners 30 in a precise  
relative position and packed in shipping cartons. Liners  
are so prepared in separate cartons for each of a number  
of different toxins or contaminants and tray sizes. The  
15    cartons are shipped to the supermarkets or packaging  
facility where the food products are packaged in trays,  
wrapped, and bar code labeled with the bar code applicator  
machine. The packaging operation takes place in the  
following order--

20       1. For each different toxin or contaminant, one of  
the corresponding liners is placed in a tray sized for the  
particular liner.

2. The food product is placed in the tray.

25       3. The food product and tray are covered with the  
wrap material.

4. The package is placed in a bar code applicator  
machine and the product identification code is entered  
through the keyboard.

30       6. The package is weighed in the machine and  
transported by the conveyor to the label application  
station.

7. The bar code applicator machine is modified to  
incorporate a label cutting die or die set in the path of  
the carrier between the roll and the printer. The die is  
35    adjustable in position and its position is set by the  
controller depending upon the particular product  
identification code. Each time a bar code label passes



1 the die, the die is actuated by the controller to form the die cut sections (33 and 34 in FIG. 9).

8. The printer is operated by the controller to print words 30 and bars 31 on the bar code labels with  
5 ordinary ink.

9. The bar code labels are applied by the machine to a precise location on the outside of the packages in alignment with substrates 28 (FIG. 6).

10 In summary, the first component of the bar code system, which requires tight manufacturing controls, is produced at a central processing plant. At the supermarket, workers without any special skill can reliably incorporate the first component into food product packages and add the second component of the bar code  
15 system in the usual way, i.e. with a bar code applicator machine. The only special training for the workers at the supermarket is the proper selection and placement of the liner (30 in FIG. 6). If a worker makes a mistake in selection or placement of a liner, bar 27 is not aligned with cutout 34 and the bar code reader senses the mistake.  
20 This provides a check to ensure that the correct toxin detecting bar has been used with the correct food product.

Substrate 32 is preferably opaque and white, or at least light in color to create a strong contrast with the  
25 bar codes, which are preferably printed in a dark color. For this reason cutouts 33 and 34 are required so substrate 32 does not hide visual elements 27 and 29 of substrate 28. If sufficient contrast is otherwise available, substrate 32 can be transparent and the cutouts  
30 can be eliminated.

In the embodiment of FIG. 11, the contamination indicator is also incorporated in a bar code system having two components--one component inside the package and another component outside the package. One component  
35 comprises a transparent bag 37 constructed from a bottom panel 36 and a top panel 38. Bag 37 is placed over hole 18 and the bottom panel 36 is secured to tray 10 by

1 adhesive to seal hole 18 and form a window. Bottom panel  
36 is fabricated from a substrate that is impervious to  
the food juices. A first antibody against the toxin of  
5 interest is bound to an area of the interior surface of  
bottom panel 36 identical in size and shape to or larger  
than hole 18. Top panel 38 is fabricated from a  
semipermeable membrane. The top and bottom panels are  
sealed together at their edges by use of an adhesive or  
10 other suitable method such as heat, to form a sealed bag,  
i.e., bag 37. Prior to sealing the bag a solution  
including a labeled second antibody against the toxin of  
interest is introduced into the bag. Although the first  
and second antibodies could be the same, they are  
15 preferably different. Thus, the second antibody  
preferably recognizes different antigenic determinants on  
the toxin than the first antibody. The second antibody is  
labeled with an indicator such as a colored latex bead so  
that the resultant labeled antibody is of a large size.  
20 The labeled antibody, present in the solution, is at a  
dilute concentration so that light will readily pass  
through the solution and so that little or no color is  
discernable.

The semipermeable membrane has a pore size which is  
25 large enough to allow the toxin of interest to enter the  
bag, but which is small enough to prevent the labeled  
antibody from leaving the bag. Such membranes are well  
known in the art and are commercially available in a  
variety of pore sizes. The pore size of the semipermeable  
panel is selected so that the toxin of interest will pass  
30 through the semipermeable panel to the interior of the  
bag.

When a toxin is present in the juices of a meat  
product packed in the tray, the toxin passes into the bag  
through semipermeable panel 38 and binds to antibodies  
35 bound to panel 36. The toxin also binds to the labeled  
second antibody present in the solution in the bag. As a  
result, panel 36 becomes colored by the sandwich assay of

1 the first antibody, the toxin, and the labeled second  
antibody, thereby indicating the presence of a toxin in  
the juices.

5 The second component comprises bar code system 16  
printed on substrate 20, which is a transparent material  
such as MYLAR®. Substrate 20 is placed over hole 18 on  
the exterior of the meat tray, and preferably outside wrap  
material 14. When a toxin is not present in the juices  
10 panel 36 remains clear and the bar code system can be  
easily read against the clear background. When a toxin is  
present in the juices, the toxin binds to panel 36 and to  
the labeled antibody such that the substrate background  
becomes densely colored. In a preferred embodiment the  
15 color of the beads used is black and the uncolored  
background is white or clear. The dense color of the  
first component prevents the bar code of the second  
component from being distinguished from the background by  
the bar code reader. This effectively obliterates or  
20 changes the bar code system and indicates that the food  
contained in the package is contaminated.

A variation of the two component bar code system of  
FIG. 11 is partially illustrated in FIG. 12. Panel 36 is  
secured to the underside of liner 30 using an adhesive or  
other suitable means of attachment. The liner is an  
25 absorbent material that draws juices and other fluids away  
from the meat to the surface of semipermeable panel 38 and  
serves to align bag 37 with hole 18, in the manner  
described in connection with FIG. 6. The juices pass  
through the semipermeable panel and into the interior of  
30 bag 37. On the interior of surface of panel 36 antibodies  
are attached as described above. The antibodies are  
attached to a rectangular area 39 on the inside surface of  
panel 36 such that when the liner is placed in the food  
tray rectangular area 39 aligns with hole 18. Substrate  
35 20 is attached to the outer surface of tray 10 after  
tray 10 has been covered with wrap material 14. A bar  
code system is printed on substrate 20 by the bar code

1 applicator machine. The presence of toxins are then  
detected as described above.

5 In another embodiment of the invention shown in FIGs.  
13 and 14, a symbol such as a colored dot 42 is printed  
on a porous substrate 40. Substrate 40 is designed to be  
attached to the surface of a beef carcass or other bulk  
food product to determine if the carcass is contaminated.  
The "ink" used to print the dot is labeled antibodies  
10 attached to toxin as described above. In the illustrated  
embodiment, substrate 40 is in two parts--a porous  
indicator strip 45 and an opaque holder strip 44 that  
covers and secures the indicator strip in place. The  
labeled antibody is bound to a square area 43 of the  
15 indicator strip. Substrate 40 comprises flexible material  
which fits the contour of the carcass and keeps the  
indicator strip in contact with the surface of the  
carcass. A circular hole 47 is cut in the holder strip  
and area 43 aligns with the hole, so that when the  
20 substrate and holder strip are attached to the carcass  
colored dot 42 appears. If toxins are present in the meat  
of the carcass the antibody becomes unbound from area 43  
and the dot disappears to indicate the presence of toxins  
in the carcass. Substrate 28 is attached to the carcass  
by use of stainless steel staples 46. The holder strip  
25 may also be used to display other identifying information,  
such as a bar code system 48 and printed matter 50. Bar  
code system 48 and printed matter 50 could be printed with  
ordinary ink.

30 The present invention is not to be limited to the  
specific embodiments shown which are merely illustrative.  
Various and numerous other embodiments may be devised by  
one skilled in the art without departing from the spirit  
and scope of this invention. For example, with respect to  
the embodiments of the present invention illustrated in  
35 FIGs. 6-12, while the invention is described for use with  
antibodies against a single toxin, mixtures of antibodies,  
against a number of different toxins could be used. With

1 the use of different antibodies, multiple, different  
toxins which could be present in the meat sample can be  
detected. Also, while the invention is described  
primarily in relation to obliterating a bar code, the  
5 antibody bound to the substrate could also be in the form  
of a symbol or wording which appears, or disappears  
depending on the type of antibody-toxin "assay" used.  
Such a symbol or wording could be read without the aid of  
a bar code reader. Also while some embodiments are  
10 described in conjunction with a liner, these bar code  
systems could also be used in the absence of a liner.  
Similarly, embodiments described without a liner could be  
used in conjunction with a liner. The scope of the  
invention is defined in the following claims.

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## 1      WHAT IS CLAIMED IS:

1.     A food contamination detector comprising:  
        a food tray for containing food;  
        an indicator in communication with juices from  
5     the food;  
        means for changing the color of the indicator  
        when a toxin is present in the juices from the food.
2.     A food contamination detector as recited in  
10    claim 1 wherein the means for changing the appearance of  
        the indicator changes the color of the indicator.
3.     A food contamination detector as recited in  
        claim 1 wherein the indicator comprises a substrate and an  
15    antibody attached to the substrate.
4.     A food contamination detector as recited in  
        claim 3 wherein the means for changing the appearance of  
        the indicator comprises a label attached to the antibody  
20    such that the antibody dissociates from the substrate in  
        the presence of the toxin.
5.     A food contamination detector as recited in  
        claim 4 wherein the label comprises a latex bead.  
25
6.     A food contamination detector as recited in  
        claim 2 wherein the means for changing the color of the  
        indicator comprises a label and an antibody attached to  
        the label, the antibody binding to the substrate in the  
30    absence of the toxin.
7.     A food contamination detector as recited in  
        claim 6 wherein the label comprises a latex bead.
8.     A food contamination detector as recited in  
35    claim 1 wherein the indicator is a bar code that becomes  
        illegible when the toxin is present.

1           9. A food contamination detector as recited in  
claim 1 wherein the change in the indicator is a symbol  
that becomes illegible when the toxin is present.

5           10. A food contamination detector as recited in  
claim 1 wherein the indicator comprises:

a first anti-toxin attached to a transparent  
substrate; and

10           a solution in contact with the first anti-toxin  
attached to the transparent substrate, wherein the  
solution comprises a labeled second anti-toxin and wherein  
the labeled second anti-toxin becomes bound to the  
transparent substrate rendering the substrate opaque in  
the presence of a toxin in the juices from the food.

15           11. A food contamination detector as recited in  
claim 10 wherein the solution comprising the second  
antibody is enclosed in a compartment.

20           12. A food contamination detector as recited in  
claim 11 wherein the compartment comprises a semipermeable  
membrane.

25           13. A food contamination detector as recited in  
claim 10 wherein the first anti-toxin recognizes an  
antigenic determinant on the toxin which is different from  
the antigenic determinant on the toxin recognized by the  
second anti-toxin.

30           14. A food contamination detector as recited in  
claim 10 further comprising a bar code aligned with the  
transparent substrate.

35

- 1           15. A food contamination detector as recited in  
claim 10 wherein the transparent substrate seals a hole in  
a food tray.
- 5           16. A food contamination detector as recited in  
claim 1 wherein the indicator includes markings which are  
removed in the presence of a toxin, the detector  
additionally comprising:  
a bar code aligned with the indicator such that  
10 the combination of the presence of markings on the  
indicator and the bar code forms an intact visible  
indicator.
- 15           17. A food contamination detector as recited in  
claim 16 wherein the markings on the indicator are formed  
by labeled antibodies bound to a substrate.
- 20           18. A food contamination detector as recited in  
claim 16 wherein removal of the markings from the  
indicator strip results in a defective indicator.
- 25           19. A food product package comprising:  
a tray in which the food product lies;  
a transparent wrap covering the tray and the  
food product;  
a first product information component disposed  
inside the wrap so it is visible from the exterior of the  
package, the first component comprising a first substrate  
and one or more first visual elements printed on the first  
30 substrate with a contaminant detecting material; and  
a second product information component disposed  
outside the wrap, the second component comprising a second  
substrate aligned with the first substrate without hiding  
the first visual elements and a plurality of second visual  
35 elements printed on the second substrate with a non-  
contaminant detecting material.



1           20. The package of claim 19, in which the tray has  
a window formed in its bottom, the first component  
            additionally comprises an absorbent liner that is  
            dimensioned to fit in the tray in a predetermined position  
5           relative to the window, and the first substrate is  
            attached to the bottom of the liner in alignment with the  
            window when the liner is in the predetermined position.

            21. The package of claim 20, in which the second  
10           substrate is aligned with the window and the first  
            substrate.

            22. The package of claim 21, in which the second  
            substrate is opaque and has one or more cutouts and the  
15           one or more visual elements of the first substrate are  
            visible through the one or more cutouts.

            23. The package of claim 19, in which the first and  
20           second elements together form a bar code.

            24. A method of detecting contamination in food  
            comprising:

                placing food that creates food juices in a tray;  
                placing in contact with the juices in the tray  
25           an indicator the appearance of which changes in the  
            presence of a toxin; and

                sensing the appearance of the indicator to  
            determine if the food is contaminated.

30           25. A method as recited in claim 24 wherein the step  
            of placing an indicator in contact with the juices  
            comprises stapling the indicator directly to the food to  
            be tested.

35           26. A method as recited in claim 24 additionally  
            comprises the step of forming the indicator by attaching  
            an antibody to a substrate.

1           27. A method as recited in claim 26 wherein the  
forming step additionally comprises attaching a label to  
the antibody so the antibody dissociates from the  
substrate in the presence of the toxin.

5           28. A method as recited in claim 27 wherein the  
forming step attaches a latex bead as the label.

10           29. A method as recited in claim 24 wherein the  
indicator is a bar code and the change in appearance of  
the indicator makes the bar code unreadable by a bar code  
reader.

15           30. A method for packaging food product subject to  
contamination, the method comprising the steps of:

printing one or more visible contaminant indicating  
elements on a first substrate with a material that visibly  
changes when subjected to a contaminant to be detected;

20           placing the first substrate in a food tray;  
placing the food product in the tray;

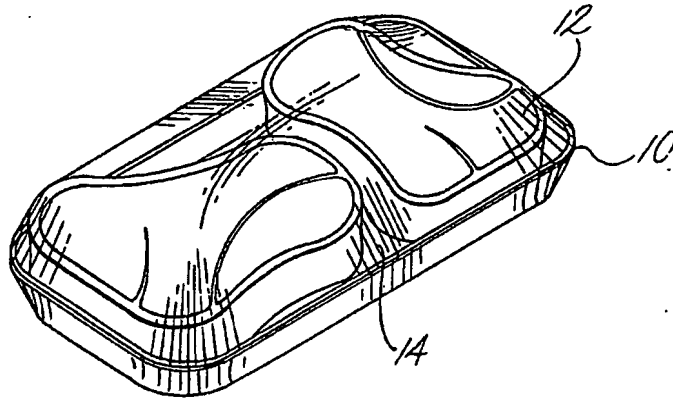
wrapping the tray and the product in a sheet of  
transparent material so the first substrate is visible;

printing a plurality of visible product identifying  
elements on a second substrate; and

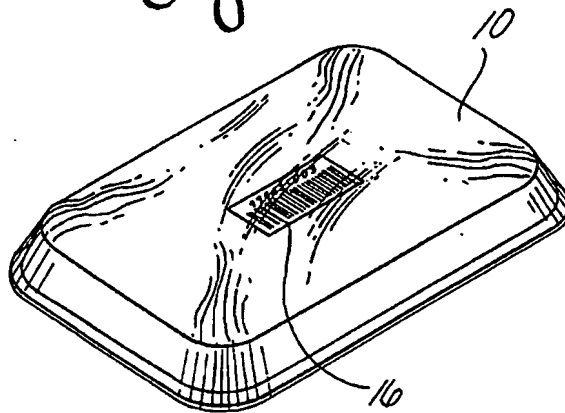
25           applying the second substrate to the exterior of the  
sheet in alignment with the first substrate without hiding  
the one or more contaminant indicating elements.

30           31. The method of claim 30, in which the step of  
placing the first substrate in a food tray comprises  
attaching the first substrate to one surface of an  
absorbent liner and placing the one surface of the liner  
in contact with the bottom of the tray in a predetermined  
position and the method additionally comprises the step of  
35           forming a window in the bottom of the tray in alignment  
with the first substrate.

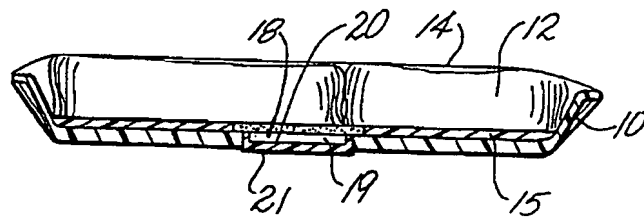
*Fig. 1*



*Fig. 2*



*Fig. 3*



*Fig. 4*

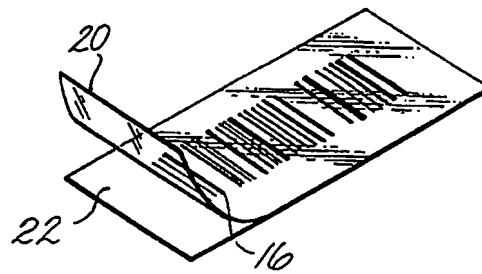
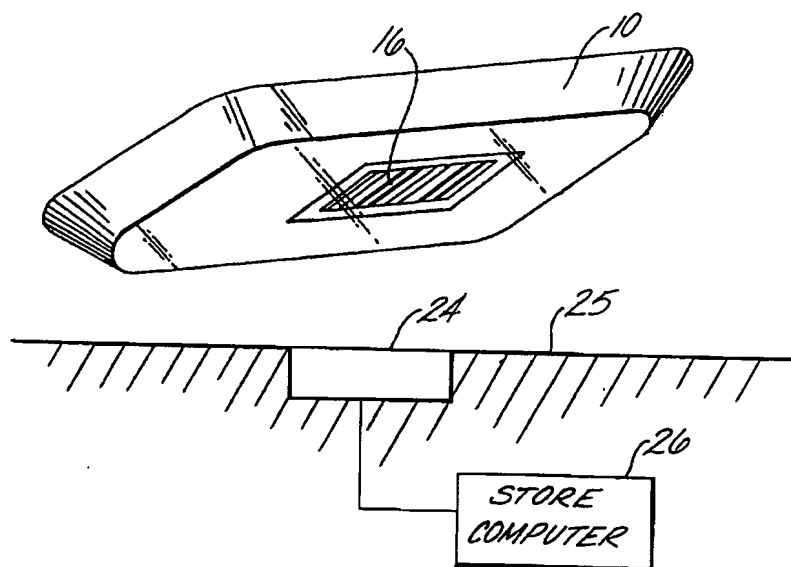
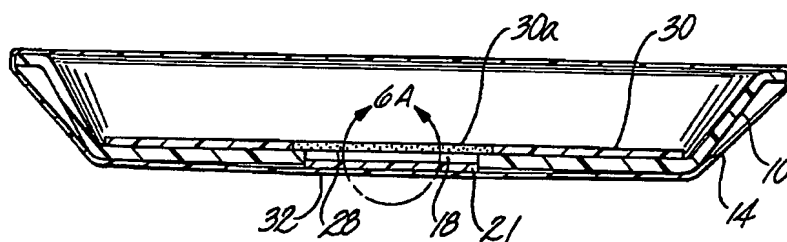


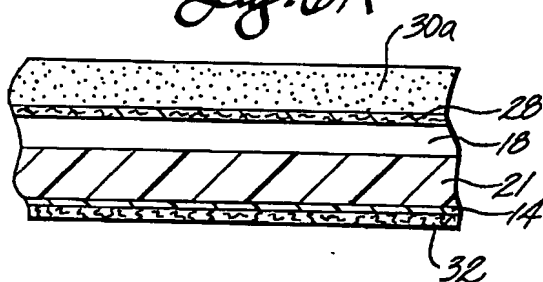
Fig. 5



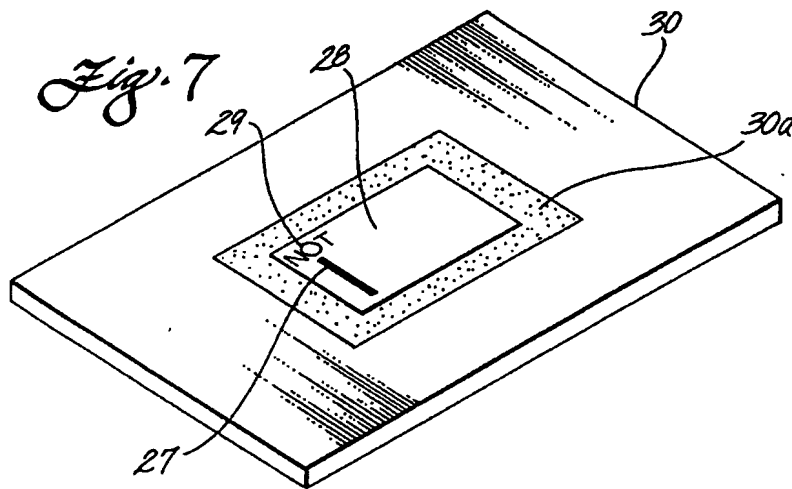
*Fig. 6*



*Fig. 6A*



*Fig. 7*



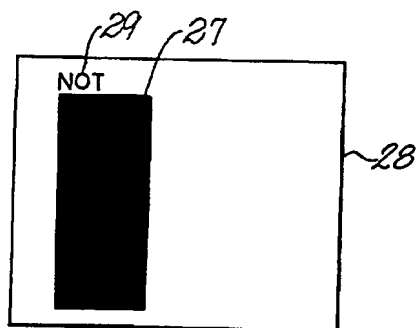


Fig. 9

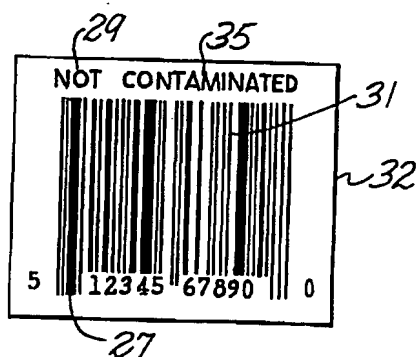
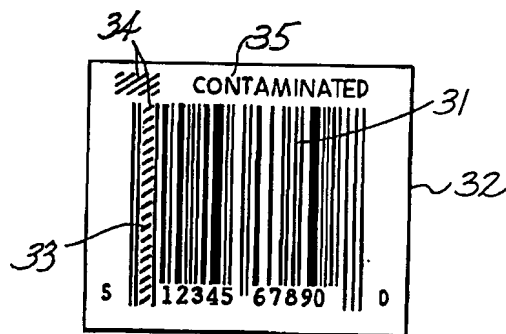
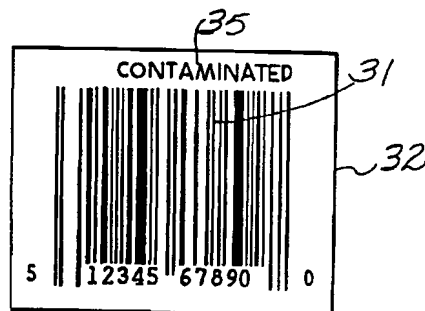
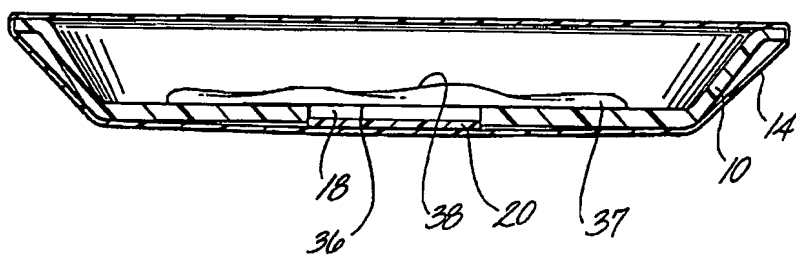


Fig. 10A

Fig. 10B



*Fig. 11*



*Fig. 12*

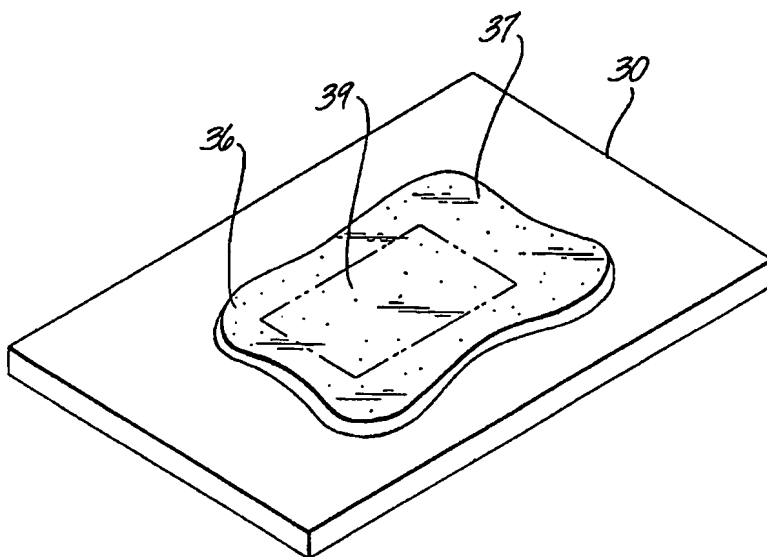




Fig. 13

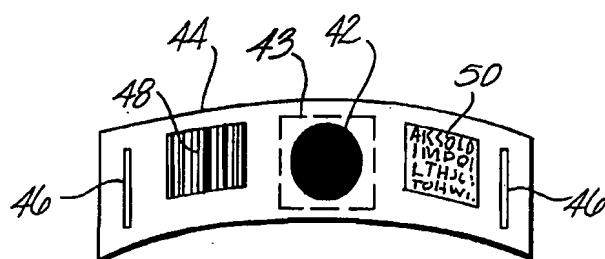
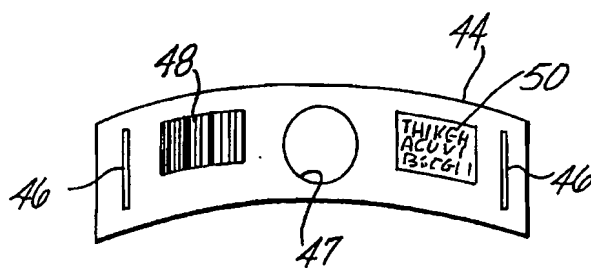


Fig. 14



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 94/05511

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 5 G01N31/22 G01N33/569 B65D77/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 G01N C12M C12Q B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 746 616 (DAVID E. HONIGS; JONATHAN H. PERKINS; BRADLEY J. TENGE) 24 May 1988 see the whole document	1,2,24, 25
Y	see the whole document	1-4, 24-26
Y	GB,A,2 234 587 (CHISSO CORPORATION) 6 February 1991 see the whole document	1-4, 24-26
A	see the whole document	1-7, 24-28
A	WO,A,91 19003 (BIOTECH AUSTRALIA PTY LIMITED) 12 December 1991 see the whole document	1-7, 10-13, 24-28

-/--

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

22 September 1994

Date of mailing of the international search report

07.10.94

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# INTERNATIONAL SEARCH REPORT

International application No.

PC1/US 94/05511

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	see the whole document	1-4, 10-12, 24,25, 30,31
A	EP,A,0 069 037 (GUY CHARVIN) 5 January 1983	

**INTERNATIONAL SEARCH REPORT**

...information on patent family members

International application No.

PCT/US 94/05511

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WO-A-9119003	12-12-91	AU-A- 7967491 EP-A- 0533772	31-12-91 31-03-93
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